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Do Voters Support Local Commitments for Climate Change Mitigation in Italy?

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ABSTRACT

There is a growing interest in voluntary programmes for climate change mitigation, including greenhouse gas (GHG) emission reduction commitments. This paper gauges evidence on the support of citizens for climate change mitigation programmes at the local level, analysing voting behaviour. A quasi-experimental set-up is offered by the EU Covenant of Mayors (CoM) initiative, which is the mainstream European movement for local authorities voluntarily committing to meet and exceed the European Union 20% GHG emission reduction target by 2020. The electoral impact of the participation of Italian municipalities to the CoM is estimated, using an instrumental variable (IV) approach. Mayors committing to reduce greenhouse gas emissions in their municipality appear not to lose electoral support at subsequent elections; this is contrary to what would be implied by a simple (biased) ordinary least squares regression. Moreover, IV point estimates are positive, albeit insignificant at standard levels; this could be due to the possibility of some support of citizens for emission reduction commitments. Finally, strong heterogeneity in socio-economic and demographic characteristics is found, with support of the CoM being more pronounced in wealthier and younger cities.

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1. Introduction

Mounting scientific evidence on the causes of climate change and its potential consequences has increased the relevance of environmental policies for greenhouse gas (GHG) emission reduction (see, for instance, the recent 'Energy Union' priority of the European Commission (EC, 2015)). However, national and local actions for climate change mitigation generate mostly global and future benefits (differently from local pollution attenuation), undermining the political incentive for it.

This paper tests one source of political incentives for climate change mitigation: the existence of an electoral dividend for mayors that commit to reduce emissions at the local level. In particular, it estimates whether the political commitment to reduce municipal emissions, undertaken within the EU Covenant of Mayors, has a positive or negative impact on electoral support at subsequent elections for incumbent mayors running for a second term.

Action for climate change mitigation requires strong and unwavering political commitment. For this reason, international initiatives are growing to overcome coordination failures and strengthen joint efforts for emission reduction, including international coalitions, voluntary agreements and peer-review processes.

The UN Framework Convention for Climate Change is the widest coalition for emission reduction. It involves more than 195 countries in the world, including the largest CO_2 emitters, all with intended nationally determined contributions submitted to the conference of Parties in Paris (December 2015). The analysis of efficiency and stability of large coalition has been studied, for example, by Bréchet et al. (2011).

Local alliances supporting voluntary agreements at different administrative levels have also been launched to involve subnational and local actors, focusing on bottom-up and multilevel governance approaches. They generally rely on the voluntary engagement of local authorities without any legally binding commitment.

International examples of local alliances for emission reduction have been growing since the early nineties. The basis of this study is the EU Covenant of Mayors (CoM). It was formed in 2008 and it is now the mainstream European movement for local authorities

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voluntarily committing to meet and exceed the European Union 20% GHG emission reduction target by 2020 (as laid down in the Europe 2020 strategy), under their mandate (Cerutti et al., 2013). Other international networks are the ICLEI - Local Governments for Sustainability, established in 1990 (ICLEI, 2014); the U.S. Conference of Mayors Climate Protection Agreement, launched in 2005 (The US Conference of Mayors, 2007); and the UN Compact of Mayors, an agreement between existing city networks created in 2014 (UN Headquarter, 2014). Interest for local climate policies is also growing in China, as analysed by Zheng et al. (2014).

A wide economic literature on the attractiveness and effectiveness of environmental voluntary agreements between public authorities and the private sector has been developed. Carraro and Lvłque (1999), Croci (2006), OECD (2003) are notable example developing an extensive assessment of the effectiveness, efficiency and adequacy of public-private voluntary agreements compared to traditional "command and control" policies. Both the policy tools used by CoM cities to induce changes in private sector emissions as well as their effectiveness rest beyond the scope of the present work.

The scope of the current work is to look at multilevel governance approaches to climate change mitigation within the public sector. The analysis of relevant drivers supporting the political engagement of mayors for climate mitigation is of key importance given the consistent contribution of cities to global emissions and the limited ability of national and supranational authorities to act at the local level, in line with the principle of subsidiarity (Collier, 1997). In particular, the electoral support for local commitments to reduce GHG emissions is under scrutiny.

Electoral incentives (in addition to the activity of lobby groups) seem to explain the stringency of environmental policies (Fredriksson et al., 2005) and the level of environmental spending (Bouton et al., 2013; List and Sturm, 2006). Environmental preferences of citizens have also been empirically proven to be a driver of new emission reduction policies at the local level (Kahn and Morris, 2009) and city climate planning (Millard-Ball, 2012). On the contrary, they seem not to be a determinant of carbon emissions for firms (Cole et al., 2013; Matisoff, 2013).

The political commitment to reduce emissions may have a positive effect on electoral results if there is a demand for environmental policies (and if the commitment is credible). When interviewed, EU citizens ask for stronger environmental protection (EC, 2007, 2011). For instance, in the 2011 Special Eurobarometer survey, EC (2011), 63% of EU citizens stated that the European Union is not doing enough to use natural resources efficiently, despite the ambitious Europe 2020 targets. But, do stated preferences translate into voting behaviour at the municipal level? Are emission reduction commitments, undertaken within a global alliance, rewarded (or punished) by voters at the local level?

The CoM provides a unique quasi-experimental setup to assess the electoral impact of emission reduction commitments at the local level. Self-selection of mayors into the CoM and the resulting endogeneity bias is solved here thanks to an intention-to-treat instrumental variable approach. An exogenous instrument for the effort required to join the movement is available through the so-called 'Covenant Territorial Coordinators' (CTCs), as described in the following sections. This allows to estimate the impact of joining the CoM on the electoral result of an incumbent mayor[1], i.e. to answer the question: "Does the CoM increase the approval of a candidate?"

The electoral effect of voluntary participation in the CoM, for the average city, is found to be null. However, socio-economic and demographic heterogeneity are found to be key in explaining the presence or absence of individual support for emission reduction commitments. Citizens living in poorer cities seem not to support emission reduction commitments, contrary to richer cities. A simple hierarchy of needs approach predicts environmental concerns to be negatively related to economic conditions, as Kahn and Kotchen (2011) found looking at the frequency of related searches on the web.

The rest of the paper is organised as follows. The details of the Covenant of Mayors are reported in Section 2. Section 3 describes the dataset while Section 4 provides the empirical framework of analysis and the identification strategy. Potential sources of endogeneity are assessed based on the literature on the political economy of environmental policies. Results are reported in Section 5. Section 6 concludes.

2. The Covenant of Mayors Initiative and Similar Policies

The Covenant of Mayors (CoM) is the mainstream European movement involving local authorities voluntarily committing to meet and exceed the Europe 2020 target of GHG emission reduction (−20 % by 2020), under their mandate.[2] It was launched by the European Commission after the adoption of the EU Climate and Energy Package, in 2008, to encourage the implementation of sustainable energy policies at the local level. Based on the subsidiarity principle, different institutional levels are invited to cooperate in order to locally address the global challenge of climate change. In particular, mayors willing to formally commit to reduce emissions need to adopt and implement a Sustainable Energy Action Plan (SEAP) within their mandates, whose consistency is ensured by the technical assessment of the European Commission - Joint Research Centre (JRC).

In 2015 the new Covenant of Mayors for Climate and Energy was announced by European Commission Directorate-General Energy. The CoM mandate was extended to cover both mitigation and adaptation, and a time horizon to 2030 (in line with the EU's 2030 climate and energy package).

In Italian municipalities, the CoM is the best known and recognized action primarily targeting the reduction of GHG emissions. This is evident from Fig. 1, reporting the standardised frequency of Google searches in Italy (overall average and time trend) for the key words "Covenant of Mayors" (solid line); "Patto dei Sindaci", the Italian translation for CoM (dash-dotted line); any "Other" similar policy discussed below (dashed line, which is flat at zero). Strong interest in the Covenant of Mayors starts in January 2010 and any alternative initiative is negligible compared to it.

The number of mayors participating in the CoM has increased over time. There were 5049 signatories over 47 participating countries by March 2013 (4916 signatories in the EU-28), corresponding to a population of 187 million (160 million in the EU-28), see Cerutti et al. (2013). By the end of 2013, they grew to 6186 signatories corresponding to 213 million inhabitants and to an overall GHG reduction commitment of 27% (7% higher than the minimum).

Italy is the European country with the highest participation rate, both in terms of number of signatories and inhabitants involved, making it the most suited State to perform a counterfactual analysis. 3355 Italian municipalities joined the CoM by the end of 2013, individually or jointly with other municipalities, corresponding to 50% of total signatories in Europe and 41% of Italian municipalities. As a result, 39 million Italians were covered by the CoM at the end of 2013, corresponding to 65% of the country population.

The adhesion to the CoM requires a noteworthy administrative and technical effort for the municipal administration. Signatories need to compute their Baseline Emission Inventory (BEI) and submit a SEAP, specifying concrete actions to reduce GHG emissions by 2020,

[1] The impact of the CoM on actual GHG emission reduction remains beyond the scope of the present study.

[2] www.covenantofmayors.eu; accessed 01/09/2015.

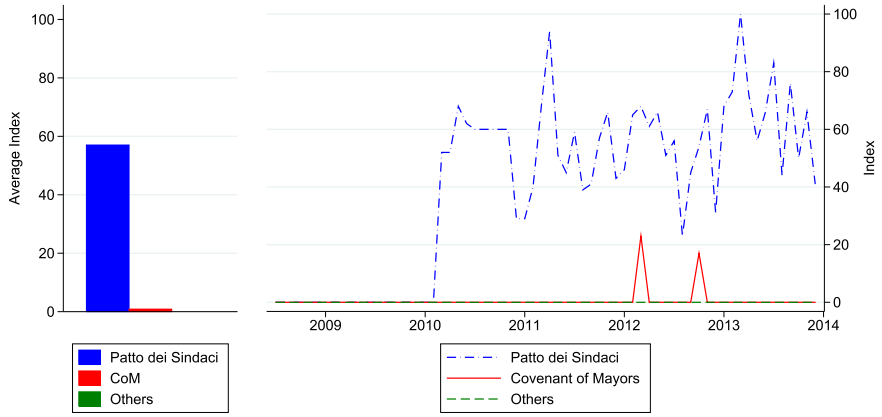

Fig. 1. Frequency of Google searches related to environmental policies in Italy. Standardised frequency of Google searches as provided by Google Trend (www.google.com/trends) for the period 06/2008–12/2013. "Others" corresponds to any of the alternative initiatives listed in Section 2.

together with an implementation strategy. The effort required to join the CoM has been rapidly considered to be a relevant barrier to entry, as reported to the authors of this paper, in private communications, by several mayors as well as experts working on the initiative.

Thus, the EC supported the organization of 'Covenant Territorial Coordinators' (CTCs) to provide financial, technical and administrative support to decrease the costs of adhesion to the CoM and to further promote the initiative. CTCs are sub-national decentralised bodies targeting the municipalities within their administrative borders (e.g. province or region). They frequently develop the BEI (with a uniform approach) and offer technical support to prepare the SEAPs, see Covenant of Mayors Office (2012b).

The active involvement of provinces and regions through CTCs, which play a pivotal role in enticing local authorities to join the initiative, was considered to be the reason for the success of the CoM in Italy (Covenant of Mayors Office, 2012a). On average, an Italian CTC coordinates 26 municipalities, but figures vary significantly as some provinces coordinate more than 100 municipalities, such as the CTC of the Province of Bergamo (186) and the Province of L'Aquila (109). The first CTCs were created soon after the launch of the CoM, in mid-2009. At the end of 2013, there were 99 CTCs in Italy, spread over the whole country.

Alternative initiatives are available in Italy to signal the green commitment of mayors; however, they are not as popular and they are expected to have a negligible effect on voting choices, when compared to the impact of the Covenant of Mayors. Moreover, they are either not specifically targeting GHG emission reductions or they do not require a formal commitment to implement environmental policies. In particular, the following initiatives are the closest to the CoM targets:

- European Energy Award (www.european-energy-award.org). This is a quality management system and certification programme to support communities willing to contribute to sustainable energy policy and urban development. Even if the certification is a signalling tool, it mainly focuses on technical support and it is particularly popular in Germany, while it clearly did not take root in Italy, apart from few cases;
- Res Champions League for Europe (www.res-league.eu) and the corresponding Italian "Campionato Solare". This is mainly focused on "*spreading the use of solar energy*" and "*showing the potential of a sustainable energy model*";
- Sustainable Energy Europe Award (eusew.eu). This highlights public and private initiatives that are actively contributing to the EU's 2020 energy and climate objectives, including CO_2 emission reduction. Even if it is a signalling tool for GHG emission reduction policies, it is not widely known in Italy, when compared to the CoM.
- The C40 Cities Climate Leadership Group (www.c40.org). This is the only initiative with the same aim as the Covenant of Mayors. However, only three Italian cities are participating in the initiative (Milan, Rome and Venice) and no particular commitment is required for it. Moreover, C40 was created in 2005, but the related award, the unique signalling tool in the initiative, was established in 2013 and it was not assigned to Italian cities in the first year. Thus, it is not a substitute signalling tool for mayors in the present sample;
- The Under 2 MOU (under2mou.org). This is a group of states and regions committing towards emissions reduction "*to help galvanize action at COP 21*". Even if it signals emission reduction commitments, cities cannot join it.

Thus, none of the above initiatives is a competitive policy with respect to the CoM, as shown in Fig. 1.

Moreover, citizens' awareness of the mayor's signing of the CoM (and related commitments) is witnessed by many paper and online records. Indeed, mayors appear to communicate extensively their adhesion to the CoM and to promote their engagement. The news is regularly reported in local newspapers, local newscast and other television programmes, as well as institutional videos on the web, with no geographical bias in the country.[3]

3. Data

This section describes the cross-section dataset constructed for the counterfactual evaluation. The unit of analysis is the Italian municipality, indicated by the index *i*. It is the smallest administrative division in Italy, governed by a mayor with political power on the management of local infrastructures and environmental issues.[4] There were 8090 municipalities in Italy in December 2013 with an average population of 7500, ranging from 30 inhabitants to 2.6 million. Mayors are elected every 5 years and they can serve only two terms consecutively.

The treatment variable is the decision to participate into the Covenant of Mayors initiative, identified with the signing date of the commitment to reduce GHG emissions. This is indicated as $sign_i$,

[3] This can be checked by searching for "Patto dei Sindaci" under the various online channels, such as YouTube, Twitter, Google News.

[4] Other responsibilities delegated to the municipal administration include the management of traffic-related issues; local police; commercial, cultural, sport, education and training activities.

Table 1
Year of first election and year of commitment to reduce emissions in the sample and Italy.

	Year of first election					Total sample	Total Italy
Signing year	2004	2005	2006	2007	2008		
No sign	1001	91	250	161	125	1628	3868
2008	5	0	1	2	2	10	20
2009	81	7	19	12	12	131	309
2010	195	13	43	39	31	321	785
2011	129	40	62	51	26	308	770
2012	146	19	34	26	14	239	630
2013	169	13	46	24	24	276	678
Total sample	1726	183	455	315	234	2913	–
Total Italy	3860	595	1213	828	564	–	7060

Number of cities in the sample by year of first election and year of adhesion to the CoM. Marginal distributions of election year and commitment year in the sample are compared with the country distribution.

which equals 1 for those municipalities whose mayor signed the CoM before the most recent election and after the previous one, 5 years earlier. It is 0 otherwise. Detailed administrative data on the Covenant of Mayors movement and participating municipalities are provided by the European Commission - DG Joint Research Centre and they are publicly available on-line on the Covenant of Mayors Office's dedicated website.[5]

The number of municipalities participating in the CoM movement is reported in Table 1, showing the joint distribution of the year of first election and the year of commitment to reduce GHG emissions within the CoM. The first municipality joined the CoM in 2008. The number of new signatories peaked in 2010 and 2011, with more than 300 mayors joining the movement. The overall pattern for Italy, including all municipalities that run an election in the period 2004–2008, parallels the sample trend.

The outcome variable of interest is the share of votes collected by candidates running for re-election between 2009 and 2013; this variable is indicated as $vote_i$. In particular, $vote_i$ equals the fraction of valid votes obtained by the incumbent candidate in the first round of re-election.[6] Data on electoral results were obtained from the publicly available on-line dataset called "Archivio Storico delle Elezioni", which provides results for all Italian regions except Valle d'Aosta, Trentino Alto Adige, Friuli Venezia-Giulia and Sicily[7]; these 16 regions include 7060 municipalities with available data for the period considered.

Only a subset of these municipalities was considered in the analysis, due to the following selection criteria. Out of 7060 municipalities reporting electoral data to the national database, only 3195 presented mayors running for a second term. The sample reduced further to 2913 municipalities due to the exclusion of cities with abnormal duration of the electoral mandate (i.e. different from 5 years),[8] municipalities that were merged with neighbouring ones and municipalities where only one candidate was present on the ballot.

Table 2 compares mean values of relevant variables in the sample municipalities with the ones of the whole of Italy. These mean values are very similar, raising no major concerns on the representativeness of the sample with respect to the Italian population of municipalities.

The instrumental variable considered in this paper is a dummy variable for the presence of a Covenant Territorial Coordinator (CTC), as introduced by some provinces and regions to help all municipalities in their area to join the CoM. The *ctc* dummy equals 1 if a CTC was available for a municipality before its most recent election and it is 0 otherwise. As a result, both municipalities that joined the CoM after and before the creation of a CTC were classified as supported by a CTC. The exogeneity of the instrument lies in the impossibility of a single mayor to influence the decision to create a CTC by a higher level of government.

The number of signatories in the sample (municipalities that joined the CoM) and the number of municipalities covered by a CTC are reported in Table 3, together with the totals for Italy. The sample is well balanced with respect to the Italian situation for municipalities having an election in the years 2009–2013.

The geographical distribution of sample signatories and territorial coordinators is reported in Fig. 2, where municipalities in white are out of the sample, yellow municipalities are those neither covered by a CTC nor participating in the CoM; light green municipalities decided to participate in the CoM without any CTC; orange municipalities decided not to join the CoM even if they received the offer to be supported by a CTC; dark green municipalities joined the CoM in areas supported by a CTC.

Control variables aim at capturing economic conditions at the local level and electoral characteristics. Average per-capita income at city level was included in logarithm. The dataset is based on taxable income at municipal level (excluding tax-deductible expenses such as private pension schemes, life insurance premium, expenses related to job reasons), as reported for the Italian annual tax declaration (IRPEF). Data is publicly available on the website of the Italian Ministry of Economy and Finance (MEF, 2015-09-30).

The number of eligible voters (in logarithm) and turnout rate (in percentage points) are included as further controls computed on data from the Italian "Archivio Storico delle Elezioni" (Ministero dell'Interno, 2014-10-31). Moreover, dummy variables identifying municipalities with 3 candidates, 4 to 9 candidates and 10 or more candidates on the ballot are included to control for non-linear effects of the number of candidates. Finally, the share of votes collected by green parties at national elections of 2006 is included to control for baseline green preferences. The share of young voters, proxied by the share of inhabitants aged 18–30, is also included.

4. Model and Instrument

This section presents the identification strategy. It describes the reference model, potential sources of endogeneity, the instrumental variable approach and evidence on the strength of the instrument.

4.1. Reference Model

The goal of the paper is to estimate the impact of joining the CoM on the share of votes collected by incumbent mayors at local elections. The reference model is:

$$vote_i = \theta \cdot sign_i + \beta' X_i + \rho \cdot vote_pre_i + \varepsilon_i \quad (1)$$

[5] http://www.covenantofmayors.eu.

[6] In Italy, the electoral system to elect mayors and members of the city council depends on the size of the city. A two-round electoral system is used in municipalities with more than 15,000 inhabitants. The first round is used to select the first two candidates, who are then voted into office in the second round (after two weeks). The second round is not executed if one candidate wins over 50% of the vote in the first round. On the contrary, direct elections are held in smaller municipalities, with up to 15,000 inhabitants. Here, a second round is organised only in case of tie. In both cases, voters can express a direct choice for the mayor or an indirect choice voting for one of the parties of the candidate's coalition. Mayors ordinarily serve a terms of five years. If a mayor resigns, dies or is ousted from office after more than half the municipal councillors stepped down, an early municipal election (for the mayor and for all municipal councillors) is called. Finally, all mayors were allowed to serve for a maximum of two consecutive terms in office until 2013. A third consecutive term has been allowed for very small cities (with <3000 inhabitants) starting from the municipal elections of 2014, and thus beyond the period of analysis considered here.

[7] See http://elezionistorico.interno.it/. Valle d'Aosta, Trentino Alto Adige, Friuli Venezia-Giulia and Sicily opted for the creation of local electoral offices and thus they do not report electoral results to the central administration.

[8] This discrepancy can be the result of administrative changes or criminal-related events.

Table 2
Summary of variables and mean comparison between sample municipalities and Italy.

	Sample	Italy	Description
Vote (%)	54.21	–	Outcome: share of votes collected by candidates running for a second term
	(15.40)	–	
Sign	0.11	0.11	Treatment: dummy equal to 1 for municipalities that signed the CoM
	(0.31)	(0.32)	
ctc	0.25	0.26	Instrument: dummy equal to 1 for municipalities covered by a CTC
	(0.43)	(0.44)	
			Controls
Income (kEUR)	10.66	10.53	Average per-capita (taxable) income at city level
	(3.08)	(3.09)	
Electorate	6.28	6.20	Number (thousand) of eligible voters at second election
	(45.45)	(35.85)	
Turnout (%)	74.74	74.20	Turnout rate at second election
	(9.48)	(9.60)	
Unique cand	0.00	0.06	Dummy for municipalities with only 1 candidate on the ballot (excluded from the sample)
	(0.00)	(0.24)	
2 candidates	0.51	0.44	Dummy for municipalities with 2 candidates on the ballot (dropped in the regression)
	(0.50)	(0.50)	
3 candidates	0.28	0.27	Dummy for municipalities with 3 candidates on the ballot
	(0.45)	(0.44)	
4–9 candidates	0.20	0.22	Dummy for municipalities with 4 to 9 candidates on the ballot
	(0.40)	(0.42)	
10+ candidates	0.0041	0.0045	Dummy for municipalities with 10 or more candidates on the ballot
	(0.0641)	(0.0672)	
Green voters (%)	1.90	1.82	Share of votes collected in the municipality by green parties at national elections of 2006
	(2.05)	(1.93)	
Age18–30	0.14	0.14	Share of inhabitants aged 18–30
	(0.02)	(0.02)	
Convergence area	0.19	0.19	Dummy for municipalities in Southern Italy
	(0.39)	(0.39)	
Observations	2913	7060	

Mean of treatment variable, instrument variable and control variables in the sample and in Italy are reported, with standard deviation in parentheses.

where $vote_i$ is the share of votes collected by the incumbent mayor at elections, $sign_i$ is the treatment dummy variable, X_i is a vector of control variables and $vote_pre_i$ is the percentage of votes collected by the incumbent mayor in the previous election (see Section 3). θ is the main parameter of interest, which characterises the impact of $sign_i$ on the expected value of $vote_i$, the β' vector resumes the effect of control variables and ε_i is the regression error. The reference model is estimated both in its static and dynamic specifications, where the static model corresponds to ρ equal to 0.

The identification of the causal effect of joining the CoM (*sign*) on voting choices (*vote*) requires to discuss the possible endogeneity bias determined by the self-selection of mayors into the programme. Individual skills, personal preferences or strategic behaviour might be exploited in different policy areas (which cannot be controlled for) and may lead to the participation in the CoM as well as to other outcomes appreciated (or opposed) by voters. This would result in a positive (or negative) bias of the estimated environmental preferences. For example, a skilled mayor that decides to join the CoM may also manage other city projects well. As a result, the change in voting choices between two elections captures the cumulative effect of supporting the CoM and being a skilled mayor.

Table 3
Signing municipalities and support from territorial coordinators in the sample and Italy.

	CTC (territorial coordinator)		Total sample	Total Italy
Sign	Absent (0)	Present (1)		
No (0)	2118	471	2589	6248
Yes (1)	77	247	324	812
Total sample	2195	718	2913	–
Total Italy	5219	1841	–	7060

Number of cities by signing status and CTC status in the sample. Totals for the sample and for Italy are reported for comparatives purposes.

Assuming that citizens support GHG emission reduction policies and skilled mayors are more likely to join the CoM, preferences for the CoM will be overestimated in a simple ordinary least squares

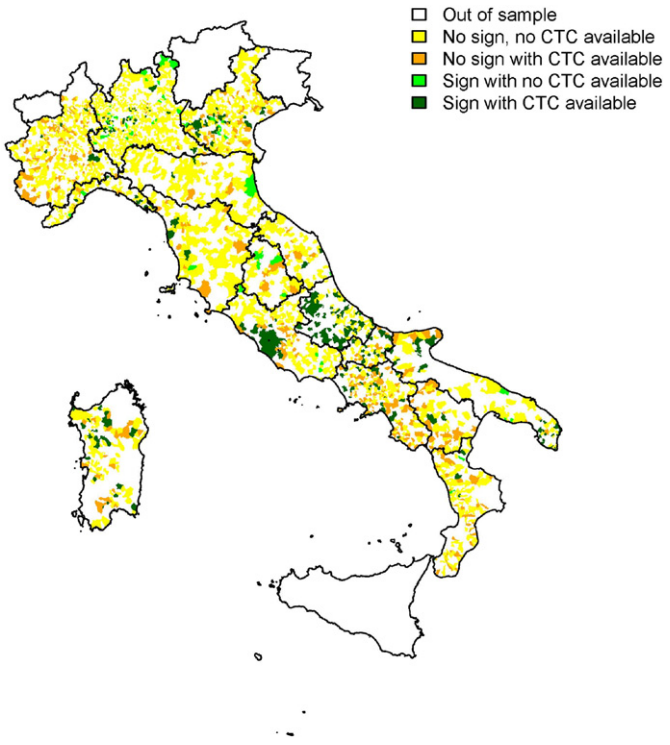

Fig. 2. Geographical distribution of cities in the sample by signing status and CTC status.

(OLS) regression using specification Eq.(1): mayors collect more votes in subsequent elections partially in recognition of their good performance and partially as a result of the willingness of citizens to reduce emissions. Since it is not possible to measure and control for the skills of a mayor, $sign_i$ can be correlated with unobservable characteristics collected in ε_i. In this case, OLS would yield biased results.

The instrumental variable technique allows solving endogeneity bias from self-selection of mayors (related to unobservable characteristics, such as skills and abilities of mayors) by making use of *exogenous* variations in the incentives to join the CoM movement. This requires an instrument that induces mayors to join the CoM (validity of the instrument), but that is independent of any other unobservable variable that is correlated with the electoral outcome $vote_i$ (exclusion restriction). In short, the instrument must have an effect on $vote_i$ only through $sign_i$.

The support for the adhesion to the CoM, offered by some provinces and regions to *all* cities in their area (creating a Covenant Territorial Coordinator, ctc_i), is a good instrument because it is expected to verify both conditions (see definition in Section 3).

An instrumental variable (IV) estimation is performed. The IV approach is appropriate for the non-dichotomous outcome variable in the second stage and generally preferred to other techniques, which require stronger specification assumptions (Wooldridge, 2002). Results are reported for errors clustered at the province level but they are robust to clustering at regional level. In light of the different geographical levels involved in the analysis (CTCs are created by regions and provinces), both specification of errors clustering are tested.

4.2. Identification Strategy

The creation of a CTC is expected to impact the probability to sign up for the CoM by decreasing informative (CTCs actively promote to mayors the CoM), administrative and financial costs. Given a set of incentives to join the CoM, including office motivation, policy motivation and political income (Persson and Tabellini, 2002), mayors face incomplete information and a budget constraint for available funds, manpower, technical capabilities, and personal skills. The creation of the CTC relieves the municipal budget constraint, allowing all mayors to join the CoM at a lower cost, by exploiting the services and funding provided by the CTC. Mayors that have already signed the CoM can also take advantage of a newly created CTC. Thus, the creation of a CTC that follows upon the decision to sign is assumed to be still correlated with the decision itself, but not with ε_i. The strength of the instrument is discussed in subsection 5.1.

The creation of a CTC is also expected to verify the exclusion restriction. This cannot be explicitly tested, but it can only be supported by theoretical arguments and empirical evidence. Firstly, the creation of a CTC is decided by a higher administrative level (province or region) and it involves technical support directed to the municipal administration only. It has no direct connection with the population in the CTC area (e.g. no connection with local political campaigns). Thus, it has no impact on local elections and on the share of votes personally collected by incumbent mayors at municipal elections.

Moreover, single mayors cannot influence the higher level decision to create a CTC, as reported by CoM project managers. Indeed, Italian regions (provinces) are composed by an average of 400 (70) municipalities. Moreover, mayors cannot self-select into the CTC by joining the CTC of different regions or provinces.

Fig. 3 reports the graph of the number of municipalities joining the CoM as a function of the date from the creation of a CTC. The number of signatories significantly increases after the creation of a CTC and no displacement effect is observed (mayors do not appear to delay their adhesion to the CoM as a result of the expected creation of a CTC). This is in line with the idea that single mayors cannot influence the creation of CTCs.

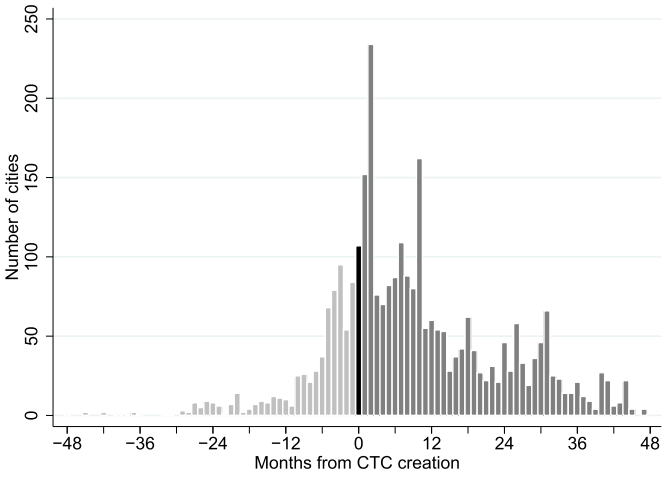

Fig. 3. Distribution of the timing of city adhesion to the CoM with respect to the date of CTC creation in their area.

No anticipatory effect (mayors anticipating their adhesion to the CoM because they foresee the imminent creation of a CTC) can bias the results because municipalities joining the CoM before the creation of a CTC are considered as covered by it.

Finally, omitted variables correlated with both the creation of a CTC and the local electoral outcome need to be ruled out. For example, political parties may be the drivers of both environmental policies and other local policies, such as land use regulation (Solé-Ollé and Viladecans-Marsal, 2013). If politicians in the two levels of government belong to the same party, then the decision to create a CTC (at province or regional level) might be correlated with other policy outcomes relevant for the electoral result (municipal level). However, most candidates in the sample are associated with a "lista civica", a list with no official connection with a national political party; this rules out possible influences via associations to the same political party.

Geographical coverage of the sample includes Italian municipalities only, assuring high homogeneity in national institutions and electoral rules.

In conclusion, ctc_i is expected to exogenously influence the decision of cities to join the CoM movement and not to have any direct impact on electoral results. The instrumental variable (IV) approach provides consistent estimates of the causal effect of the voluntary commitment to reduce emissions on electoral results, without analysing the political process leading mayors to join the CoM, which remains beyond the scope of this paper.

5. Results

This section reports the estimated average treatment effect and its heterogeneity with respect to economic and demographic characteristics. First stage results are reported first; the main result is reported in Subsection 5.2; heterogeneity of preferences is reported in Subsection 5.3.

5.1. Strength of the Instrument

In this subsection the strength of the ctc_i instrument is measured. Table 4 shows the first stage estimation results where the endogenous explanatory variable $sign_i$ of model Eq.(1) is regressed on the instrument (specification A). Controls X_{it} are included in specification B. Both specifications A and B are static, while specification C is dynamic.

The instrument appears relevant in all models. The creation of a CTC is positively correlated with the decision to join the CoM with

Table 4
Supporting authorities and adhesion to the CoM (first stage).

Specification regression	(A) OLS	(B) OLS	(C) OLS
ctc	0.34***	0.33***	0.33***
	(0.05)	(0.05)	(0.05)
Log-income		−0.02	−0.02
		(0.05)	(0.05)
Log-electorate		0.02***	0.02***
		(0.01)	(0.01)
Turnout (%)		−0.00	−0.00
		(0.00)	(0.00)
3 candidates		−0.00	−0.00
		(0.01)	(0.01)
4–9 candidates		0.02	0.02
		(0.02)	(0.02)
10+ candidates		0.09	0.09
		(0.11)	(0.11)
Green voters (%)		−0.00	−0.00
		(0.00)	(0.00)
Age18–30		0.00	0.00
		(0.00)	(0.00)
Convergence area		−0.09**	−0.09**
		(0.04)	(0.04)
vote_pre			−0.00*
			(0.00)
Constant	0.03***	0.26	0.29
	(0.01)	(0.45)	(0.44)
Observations	2913	2913	2913
R^2	0.215	0.237	0.238
F	46.77	11.68	11.17

First stage OLS regression of sign on ctc for the cross section of cities in the sample. Specification (A) is the simple regression of sign on ctc. Specification (B) includes all available controls but the share of vote collected by the incumbent mayor at previous elections *vote_pre*. Specification (C) includes also the latter.
Standard errors in parentheses. Errors are clustered at regional level.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

strong statistical significance. Interpreting the relation as a linear probability model, as a first approximation, the creation of a CTC increases the probability to join the CoM by more than 30 points.

Moreover, the 1st stage F-statistic for the OLS regression is always above the reference value of 10, suggesting the instrument not to be weak.

5.2. Main Results

Table 5 contains a summary of treatment effect estimates. Ordinary least squares (OLS) are compared to instrumental variable (IV) estimates.

The first model estimates a pooled OLS regression on the cross section of second elections. OLS estimates are included only for comparison purposes, given that OLS is possibly biased due to the endogeneity of $sign_i$. In fact, mayors voluntarily choosing to take the commitment to decrease GHG emissions have unobservable characteristics (e.g. skills) that are likely to be driving both their choice to join the CoM and subsequent electoral results.

The second model introduces municipal controls and the third further includes the share of votes collected at previous elections by incumbent mayors. The OLS point estimate is always negative and significant but increasing towards zero at the increase of control variables included in the model. Indeed, the treatment may still be endogenous despite controlling for available socio-economic characteristics at municipal level.

When applying the unbiased IV approach, the estimated effect of signing on the share of votes collected by incumbent mayors at elections is never statistically different form zero (Table 5). Point estimates for IV models including control variables are positive and equal to about 3%, see columns (E) and (F). The difference between OLS and IV estimates documents the endogeneity bias.

Mayors committing to reduce greenhouse gas emissions in their municipality appear not to lose electoral support at subsequent elections in the IV estimation; this is contrary to what would be implied by a simple (biased) OLS regression. Moreover, IV point estimates of the effect of signing up for the CoM are positive.

Indeed, IV estimates of specifications (E) and (F) show that the commitment to reduce GHG emissions by 20% or beyond do not have a negative impact on the share of votes collected at subsequent elections by incumbent mayors, despite the opposite indication given by a simple (biased) OLS regression. On the contrary, IV point estimates are positive, albeit insignificant; this is compatible with the possibility of some support of citizens for emission reduction commitments, even if no statistical significance is found at standard levels. The increase of standard errors in specifications (D) to (F) is a common feature of the IV approach which contributes to the low statistical significance of point estimates (marginally lower than standard thresholds). Finally, the dynamic specification (F) does not differ significantly from specification (E).

Summarizing, voters do not oppose the commitment taken by incumbent mayors to meet and exceed the Europe 2020 target for emission reduction at local level. Positive point estimates, though not significant at standard thresholds, could be due to some preference for mayors joining the initiative.

5.3. Heterogeneity

The IV approach yields the average causal effect of signing on electoral results for the mayors that react to the instrument. In order to test heterogeneity in environmental preferences for GHG emission reduction, the same model is estimated for a partition of the sample. This is built according to the sample median of income per capita, income growth and the share of young population (aged 18–30) at municipal level. Moreover, the unemployment rate at the local labour system level is used to capture characteristics related to the labour market. The local labour system is the lowest available level of disaggregation for unemployment in Italy. This is a geographical grouping of neighbouring municipalities computed according to the highest frequency of home-work trips registered in the 2001 Census in Italy.[9] It results in 686 local labour systems, grouping an average of 12 municipalities (from 1 to 124) with an average population of almost 90,000 (from 3300 to 3.7 million inhabitants) and an average size of 440 km^2 (from 10 to 3700 km^2).

Table 6 shows the estimated model in the sub-samples for income and income growth. Table 7 reports results for the unemployment rate and age structure sub-samples. Total observations, the number of signatories and CTCs are reported in the table and they result to be balanced between sub-samples. Statistical significance at 5% level is never detected, but a common pattern can be seen. Adverse economic conditions, such as low income (sub-sample Y^l), low income growth (sub-sample Y_g^l) and high unemployment (sub-sample U^h), are always associated with lower point estimates for the commitment to reduce GHG emission, with respect to municipalities with lower unemployment (sub-sample U^l), higher income (sub-sample Y^h) and higher income growth (sub-sample Y_g^h). Overall, economic conditions seem to influence the electoral support for climate change mitigation: the richer the city, the higher the support of citizens for climate commitments.

The age structure of the population (Table 7) seems to influence revealed environmental preferences as well. A higher share of young voters (sub-sample *Young*) is associated with a positive (though statistically not significant) effect of the CoM on voting. Conversely, a relatively older electorate (sub-sample *Old*) is associated with a nearly zero effect of the CoM on electoral support.

[9] The analysis is performed by ISTAT, the Italian Institute of Statistics.

Table 5
Impact of sign on vote share.

Specification regression	(A) OLS	(B) OLS	(C) OLS	(D) IV	(E) IV	(F) IV
Sign	−4.62***	−2.11**	−1.70*	−1.85	2.91	3.58
	(1.19)	(0.96)	(0.95)	(2.26)	(2.37)	(2.27)
Log-income		2.68	1.98		2.84	2.13
		(1.71)	(1.67)		(1.83)	(1.78)
Log-electorate		−1.30***	−0.63*		−1.42***	−0.74*
		(0.38)	(0.37)		(0.39)	(0.38)
Turnout (%)		−0.21***	−0.20***		−0.18***	−0.17***
		(0.04)	(0.04)		(0.04)	(0.04)
3 candidates		−8.82***	−8.59***		−8.88***	−8.65***
		(0.58)	(0.56)		(0.59)	(0.56)
4–9 candidates		−16.17***	−16.06***		−16.51***	−16.41***
		(0.93)	(0.88)		(0.93)	(0.87)
10+ candidates		−18.46***	−18.95***		−19.39***	−19.94***
		(4.07)	(4.25)		(4.32)	(4.52)
Green voters (%)		0.22**	0.23**		0.24**	0.26**
		(0.10)	(0.10)		(0.11)	(0.11)
Age18–30		−0.26	−0.15		−0.27	−0.16
		(0.19)	(0.18)		(0.19)	(0.19)
Convergence area		−1.25	−1.92		−1.10	−1.78
		(1.32)	(1.29)		(1.34)	(1.30)
vote_pre			0.20***			0.20***
			(0.02)			(0.02)
Constant	54.72***	55.76***	48.49***	54.42***	52.07***	44.40***
	(0.51)	(15.92)	(15.74)	(0.56)	(17.05)	(16.70)
Observations	2913	2913	2913	2913	2913	2913
R^2	0.009	0.243	0.271	0.005	0.234	0.260

Estimation of the impact of signing the CoM on the share of votes collected at subsequent elections for the cross section of cities in the sample. Specification (A) is the simple OLS regression of *vote* on *sign*. Specification (B) and (C) include all available controls with and without the lagged vote share *vote_pre*, for the simple OLS regression. Specification (D) is the two stage regression of *vote* on *sign*, instrumented by *ctc*. Specification (E) includes additional controls and specification (F) includes also *vote_pre*.
Standard errors in parentheses. Errors are clustered at regional level.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 6
Heterogeneous impact on vote share - income.

Subsample	Y^h	Y^l	Y_g^h	Y_g^l
Sign	8.58*	0.83	3.00	1.17
	(4.47)	(2.61)	(3.04)	(3.24)
Log-income	−0.60	5.51***	3.99**	2.74
	(4.11)	(2.03)	(1.92)	(2.53)
Log-electorate	−1.15**	−1.78***	−0.72*	−1.90***
	(0.57)	(0.54)	(0.42)	(0.57)
Turnout (%)	−0.06	−0.22***	−0.19***	−0.21***
	(0.08)	(0.04)	(0.04)	(0.07)
3 candidates	−9.11***	−8.70***	−8.77***	−9.00***
	(0.81)	(0.89)	(0.85)	(0.79)
4–9 candidates	−17.23***	−16.08***	−16.45***	−16.09***
	(1.16)	(1.57)	(1.40)	(1.18)
10+ candidates	−21.49***	0.00	0.00	−17.38***
	(4.42)	(.)	(.)	(4.41)
Green voters (%)	0.15*	0.34	0.57**	0.02
	(0.08)	(0.21)	(0.25)	(0.12)
Age18–30	−0.70**	0.02	−0.01	−0.61**
	(0.30)	(0.19)	(0.22)	(0.27)
Convergence area	12.25***	−1.42	−3.70**	3.12*
	(3.87)	(1.34)	(1.50)	(1.81)
Constant	80.25**	26.91	38.36**	60.03**
	(39.76)	(19.01)	(18.03)	(25.26)
Observations	1457	1456	1457	1456
NumSign	138	170	104	204
NumCTC	278	399	247	430

IV estimation of the impact of signing the CoM on vote share for sub-samples of cities. Sub-samples are created according to the value of selected variables being above ($\cdot^h$) or below ($\cdot^l$) the sample median. Specifications (Y^h) and (Y^l) refer to income per capita on the year of first election. (Y_g^h) and (Y_g^l) refer to income per capita growth between first and second elections.
Standard errors in parentheses. Errors are clustered at regional level.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 7
Heterogeneous impact on vote share - unemployment and age structure.

Subsample	U^h	U^l	*Young*	*Old*
Sign	1.78	4.86	4.36	0.19
	(2.55)	(7.07)	(3.02)	(3.19)
Log-income	5.87***	−0.68	6.41***	0.08
	(1.79)	(2.50)	(2.10)	(2.33)
Log-electorate	−2.06***	−0.80	−0.82*	−1.49***
	(0.56)	(0.65)	(0.49)	(0.51)
Turnout (%)	−0.18***	−0.21***	−0.16***	−0.24***
	(0.05)	(0.07)	(0.05)	(0.06)
3 candidates	−7.96***	−9.82***	−10.49***	−7.31***
	(0.92)	(0.78)	(0.76)	(0.85)
4–9 candidates	−15.50***	−17.53***	−19.42***	−14.33***
	(1.41)	(1.21)	(1.26)	(1.06)
10+ candidates	−17.88***	−12.24***	−10.53***	−19.36***
	(5.01)	(2.98)	(1.89)	(4.70)
Green voters (%)	0.21*	0.09	0.30	0.19
	(0.12)	(0.65)	(0.20)	(0.13)
Age18–30	0.12	−0.56*	0.73**	−0.71**
	(0.23)	(0.29)	(0.30)	(0.36)
Convergence area	−0.82	0.72	−0.92	−4.02*
	(1.48)	(2.20)	(1.38)	(2.11)
Constant	18.92	90.66***	1.98	86.86***
	(17.16)	(22.67)	(20.56)	(21.94)
Observations	1465	1448	1457	1456
NumSign	243	65	167	141
NumCTC	567	110	373	304

IV estimation of the impact of signing the CoM on vote share for sub-samples of cities. Sub-samples are created according to the value of selected variables being above ($\cdot^h$) or below ($\cdot^l$) the sample median. Specifications (U^h) and (U^l) refer to unemployment rate on the year of first election. Specifications (*Young*) and (*Old*) include cities where the share of people aged 30 or below is above or below the sample median, respectively (at first election).
Standard errors in parentheses. Errors are clustered at regional level.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Summarizing, voters prove not to oppose further reduction of GHG emissions and their voting behaviour seems to be consistent with preferences stated in the Eurobarometer survey. The formal commitment to reduce GHG emission by 20% or beyond has a causal average positive impact on the likeability of candidates. This is estimated to be about 3 percentage points of vote share collected at elections by incumbent mayors. However, no statistical significance is found at the 10% level. Moreover, preferences are heterogeneous with respect to economic and demographic characteristics. Better economic conditions and a high share of young individuals in the population are associated with higher positive effects of joining the CoM.

6. Conclusions

This study presents evidence in line with the hypothesis that the Covenant of Mayors (CoM) can be a self-sustainable approach to strengthen efforts for climate change mitigation at the local level. The CoM is the mainstream European movement involving local authorities voluntarily committing to reduce emissions by 20% (or beyond) by 2020 under their mandate. The causal effect of the adhesion to the CoM on electoral results of incumbent mayors is estimated for a sample of Italian municipalities, via an instrumental variable approach, using a number of control variables.

The central finding is that citizens do not oppose the commitment to reduce GHG emissions by 20% and beyond by 2020, as required to participate in the CoM. Indeed, taking the commitment to reduce emissions at the municipal level does not cause a loss of votes for mayors at subsequent elections. Point estimates of the gain in electoral votes are positive but statistically insignificant at the 10% level, possibly because of the higher standard errors, typical of the IV approach.

Heterogeneity is found across economic and demographic characteristics. Municipalities with higher income, lower unemployment and a higher share of young people show a higher positive effect of the commitment on the vote share of incumbent mayors.

These findings are obtained using some control variables, and under the exogeneity assumption for the instrument; the latter amounts to the assumption that the institution of a Covenant Territorial Coordinator (CTC) is exogenous to the local mayoral elections. As always, availability of more control variables and/or of more instruments would allow for more precise inferential results; further research may improve on this situation.

The present results are consistent with both the widely pledged support stated in opinion surveys, such as the Special Eurobarometer 365, and with the global and intergenerational dimension of climate change. Finally, the current study focused on emission reduction commitments. Implementation of GHG reduction measures is on-going and the monitoring reports will reveal their effectiveness in the near future.

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